



The Southeastern Mediterranean Sea shifts from atmospheric CO₂ sink to source in response to the damming of the Nile and warming

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Marginal seas and shelf environments exhibit a variable behavior with respect to air-sea CO₂ fluxes in response to large variations in temperature, primary productivity, freshwater balance etc. The Southeastern Mediterranean Sea (SEMS) represents an extreme example of a marine system radically altered due to anthropogenic forcing such as the damming of the Nile, which reduced fresh water and nutrient input to the basin, and significant warming over the last few decades. Here we present a long-term record of seawater pH in the SEMS, which is a combination of a reconstructed record together with more recent in situ measurements that demonstrate the SEMS response to these pressures. The reconstructed record is derived from high resolution measurements of $\delta^{13}\text{C}$ of vermetid reefs together with a long time series of hydrographic data following the damming of the Nile. The record indicates that the SEMS has experienced a significant acidification of $\Delta\text{pH}/\Delta t = -0.022 \pm 0.002$ decade⁻¹. This rate exceeds those of the open-ocean time series, but is lower compared to rates measured in the Western Mediterranean Sea. The continued increase of salinity/alkalinity in the SEMS since the damming of the Nile appears to have strengthened the carbon buffer with respect to acidification, which lowered the acidification rate of this region by an estimated 27%. However, this is masked by the effect of relatively rapid warming trends ($\sim +1$ °C/decade) in the region which resulted in nearly year-round super-saturation of pCO₂ in the surface layer of the SEMS. Ongoing measurements of the carbonate system since 2009 in the SEMS indicates that the system is thermodynamically governed, with a minimal biological feedback. The SEMS has become a net source of atmospheric CO₂ annually on the order of 0.44 Tg C y⁻¹, a figure that is expected to grow with continued warming in the future.